Fatigue Management for Improved Aviator Performance

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Memorable Fatigue Moments from the Recent Past

- **Accident at Three Mile Island nuclear power plant-**
  - **Destruction of Unit 2 reactor and release of radioactive gases and water into the environment**
- **Nuclear meltdown at Chernobyl -**
  - **300 deaths, $13 billion in economic disruption, increased cancer rates and birth defects**
- **Release of poisons from Union Carbide in Bhopal-**
  - **2,800 deaths, 20,000 cases of respiratory and eye damage, and $3 billion in immediate costs**
- **Grounding of the Exxon Valdez -**
  - **1400 miles of shoreline contaminated, over $8 billion in direct costs**

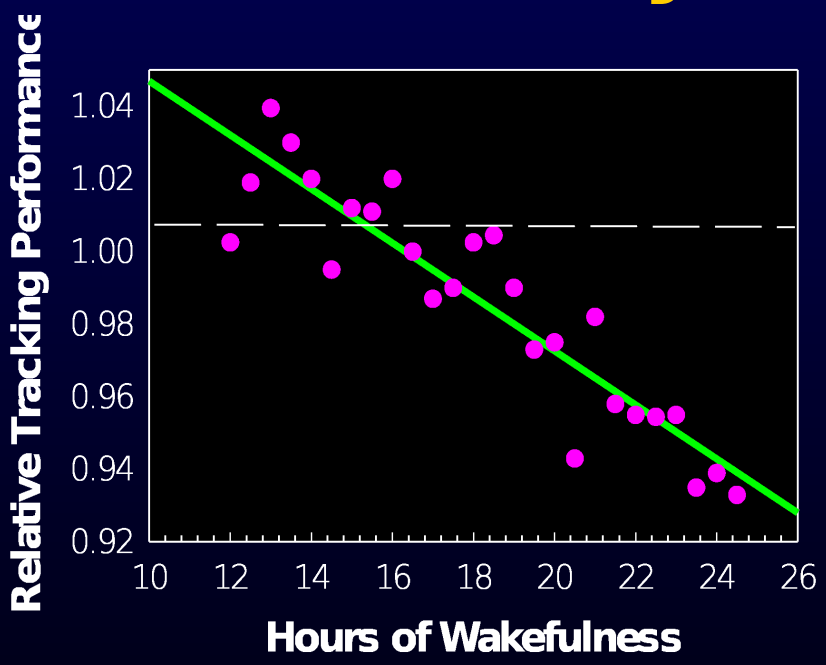
Causative Factors in These and Other Accidents

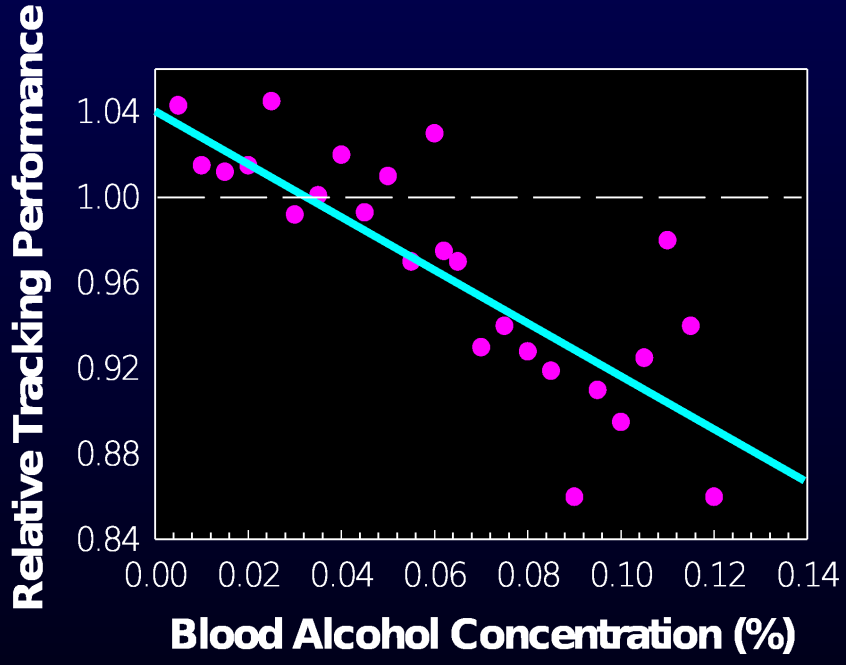
- All occurred in the early morning hours when fatigue levels were high -
  - Sleepiness and circadian disruptions (from shift work) were significant factors
- Equipment, mechanical, or procedural errors often initiated the fateful chain of events -
  - At TMI, maintenance workers had closed auxiliary valves; at Chernobyl, a nonstandard procedure was being conducted
- However, the fatigue-related decrements in reaction time and judgement ultimately created the disaster-
  - Obvious courses of action were overlooked, mistakes were made, and standard safety procedures were ignored

Fatigue Degrades Performance and Mental Abilities

- Accuracy and timing degrade
- Lower standards of performance become acceptable
- Attentional resources are difficult to divide
- The ability to integrate information is lost
- Everything becomes more difficult to perform
- Social interactions decline
- The ability to logically reason is impaired
- Attention wanes
- Attitude and mood deteriorates
- Involuntary lapses into sleep begin to occur

Fatigue-related Decrements are Similar to Those Caused by Alcohol





Source: Dawson and Reid, 1997

Fatigue is Becoming a Recognized Problem in Transportation

- Tour bus crashes in 98 and 99 focused attention on hours of service regulations for drivers
  - Insufficient rest is thought to be responsible for driver errors
- Fatigue made the top-10 list of transportation safety issues because of trucker crashes
  - Thirty-one percent of all trucker fatalities are fatigue related
- In 1993, the first-ever commercial aviation accident was attributed to fatigue (DC-8 crash, Guantanamo Bay). Since, there have been others
  - Korean Air flight 801 was attributed partially to crew fatigue
  - The 1999 Arkansas crash might have been due to fatigue
- Driver drowsiness causes 100,000 accidents a year
  - The cost to society is estimated at more than $12 billion

Falling Asleep at the Wheel is No Laughing Matter

Thag Anderson becomes the first fatality as a result of falling asleep at the wheel.

Fatigue Costs Everyone

- Three-quarters of workers report fatigue impairs their ability to make important decisions
- Half of adults say sleepiness degrades quality of life (poorer mood, energy, health, and family relations)
- NHTSA reports driver drowsiness causes 100,000 accidents, 1,500 fatalities, 71,000 injuries, and $12.5 billion a year in monetary losses
- Sleepy personnel cost employers $18 billion annually in lost productivity
- Expenses from litigation and criminal prosecutions due to fatigue-related accidents are on the rise

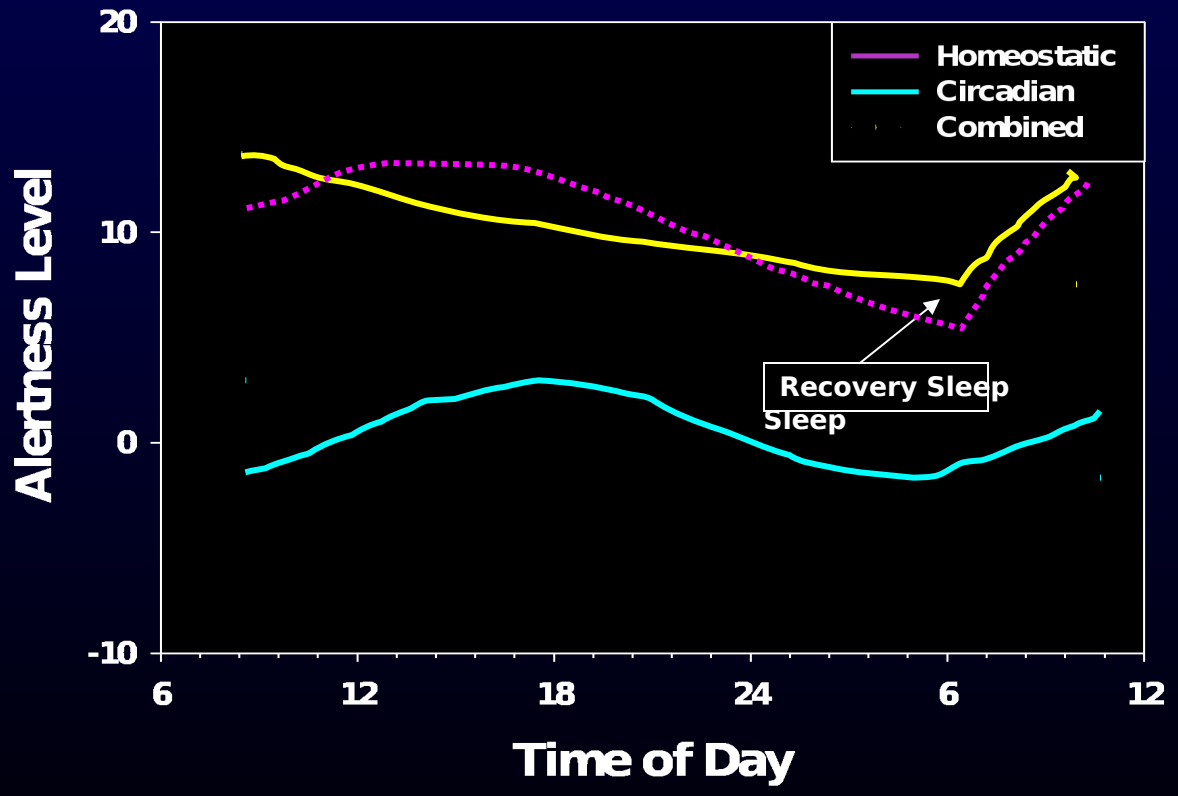
Fatigue is More of a Problem Now than Ever Before

- Most living creatures rely on the natural day/night cues to govern their activity and rest cycles
- However, in 1883 the electric light changed that by extending the work day (and increasing production)
- In the past century, Americans have reduced their sleep time by 20% (from 9 down to 7 hours a night)
- Since 1969, we have added 158 hours a year to our working and commuting time
- Over 25 million people now routinely engage in shift work (and many of these are in the military)

All Work and No Sleep Makes for a Bad Day

- The effects of inadequate sleep cannot be overcome by motivation, training, or experience
- The need for sleep is a basic biological drive just like hunger and thirst
- Alertness and ability to perform is a function of two factors:
  - the circadian pacemaker (body clock), which makes alertness better at some times than at others
  - the amount of time since the last sleep period, which is a primary determinant of fatigue
- Ignoring these factors increases fatigue and sleepiness, resulting in poor performance

Alertness Depends on Homeostatic and Circadian Factors



Source: Åkerstedt, 1995

Important Points to Remember When Dealing with Aviator Fatigue

- Humans have rhythms that affect performance, and they can’t quickly change to new schedules
- Even the most expertly maintained aircraft can’t prevent the errors made by fatigued pilots
- Repeated exposures to sleep deprivation can’t “train” an aviator to overcome fatigue
- Incentives may increase the willingness to work longer duty hours or reverse cycles, but won’t improve safety
- There’s no “one-size-fits-all” schedule that fits everyone-- (some people need 7 hrs of zzz’s while others need 9)
- Just because a lot of pilots are lucky enough not to have fatigue-related accidents doesn’t mean fatigue isn’t a real problem

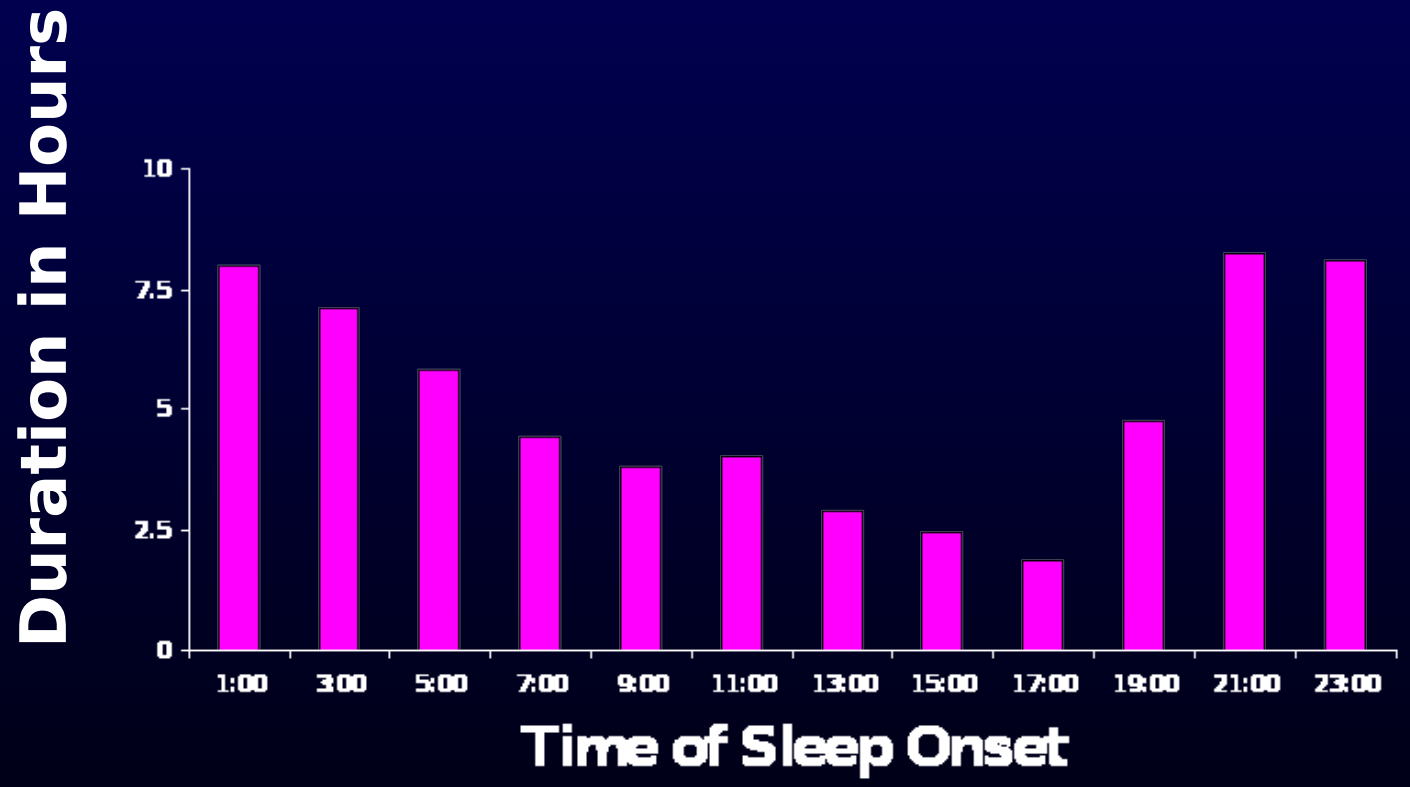
Realistically, What Can Be Done?

- Several strategies are potentially useful to overcome fatigue in the workplace
  - **Avoidance of night work/Proper shift scheduling**
  - **Sufficient daily sleep**
  - **Strategic naps**
  - **Rest breaks**
  - **Exercise**
  - **Environmental stimulation**
  - **Physical fitness**

Avoid Night Work and/or Develop Proper Shift Schedules

- Subjective complaints of sleepiness, fatigue, and poor performance are big problems for personnel working reverse cycle
- Thus, make efforts to:
  - Avoid night duty and/or reduce demands on night workers
  - Avoid long shifts since fatigue at night is already problematic
  - Schedule crews in ways that ensure enough daily sleep
  - If using split shifts, schedule them so personnel will have their time off when sleep is naturally easy to obtain
  - Ensure clockwise transitions when changing work schedules
- Remember, people never really adjust to night work

Hours of Sleep Obtained by Time of Sleep Onset

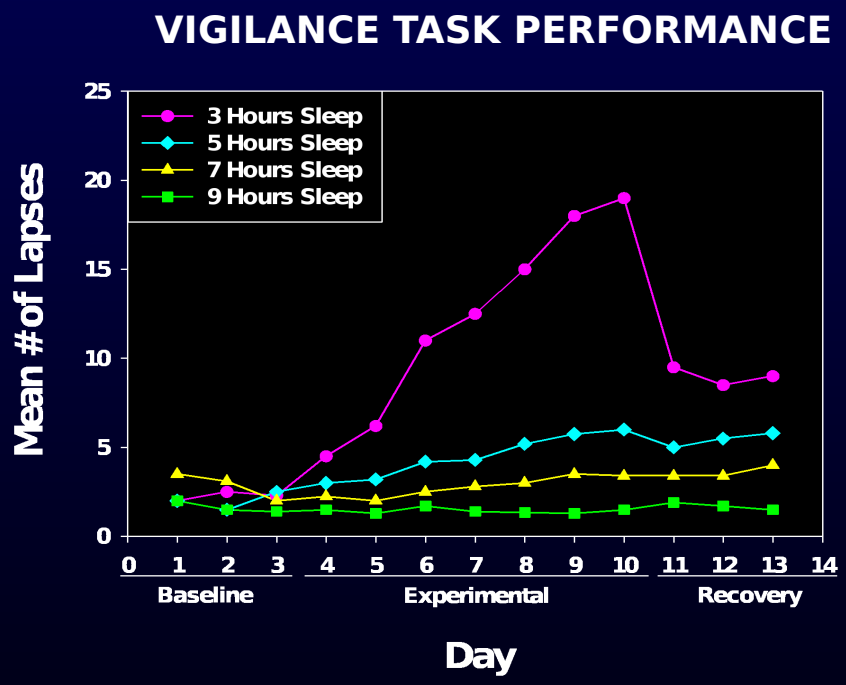


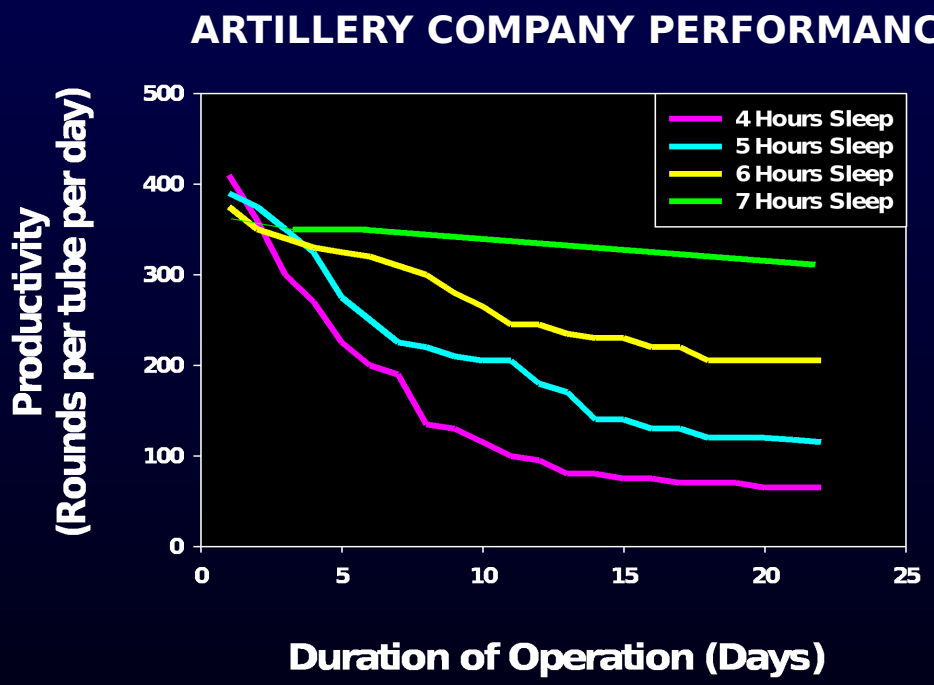
Source: Smiley, 1998

Emphasize Sufficient Sleep on a Daily Basis

- Sleep restriction severely degrades performance
- When sleep is less than 6 hours per night, fatigue becomes a problem almost immediately
- When sleep is cut to less than 4 hours per night, uncontrolled sleep attacks occur
- Thus, make sleep a priority and remember:
  - 7 hours per night is the minimum requirement
    - *However, some people will need more*
  - Determining individual needs is a trial-and-error process
  - You'll know you've found the right amount when it's easy to stay alert even during boring and/or sedentary tasks
- You can't train yourself to get by on less sleep!

Chronic Sleep Restriction Has Its Price



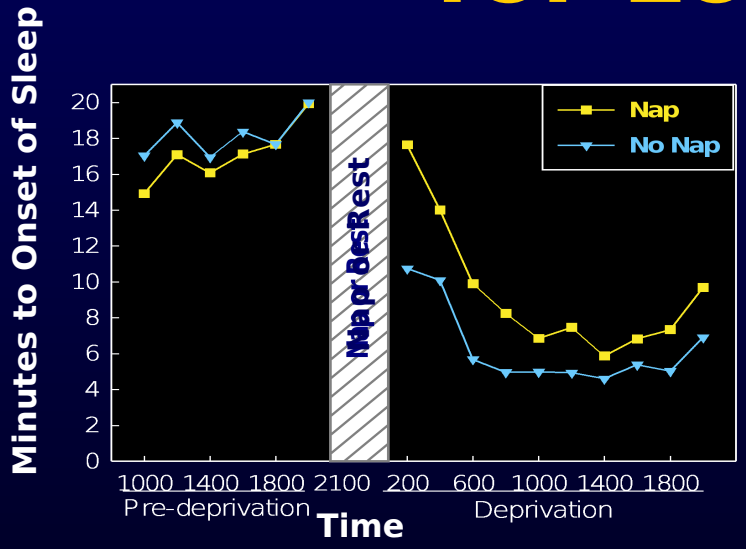


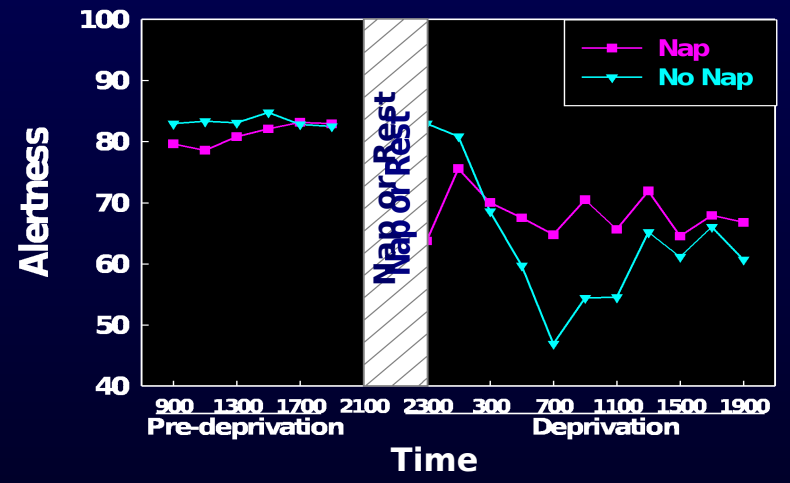
Source: Belenky et al. 1994; Belenky, 1998

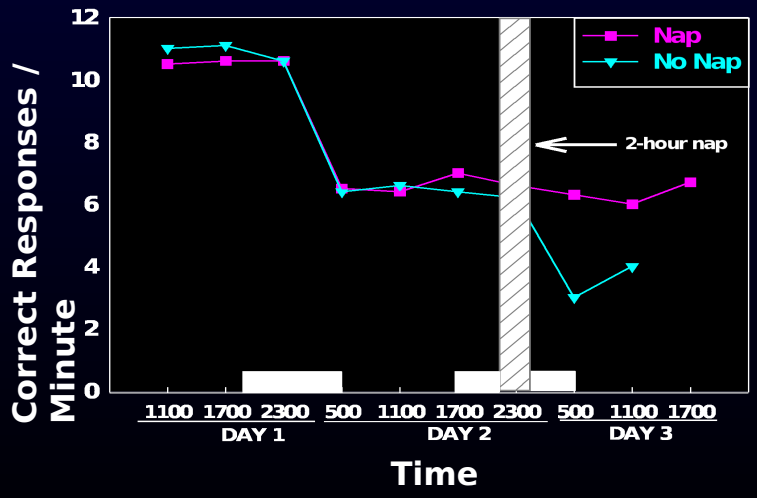
Take Advantage of Strategic Naps

- Naps can maintain or restore performance when sleep is shortened, disrupted, or missed altogether
- Naps ranging from 40 minutes to 2 hours are best, but even short naps (15-20 minutes) are better than nothing
- To implement naps:
  - Create a quiet, dark, cool environment (mask out noise & light)
  - Plan naps at conducive sleep times (0100-0500 or 1400-1600)
  - Place naps early in the SusOps period (or before sleep loss)
  - Set aside as much time as possible for the nap
  - Allow time for sleep inertia to dissipate
- Naps can bridge the gap between regular sleep periods

Naps Can Temporarily Make Up for Lost Sleep





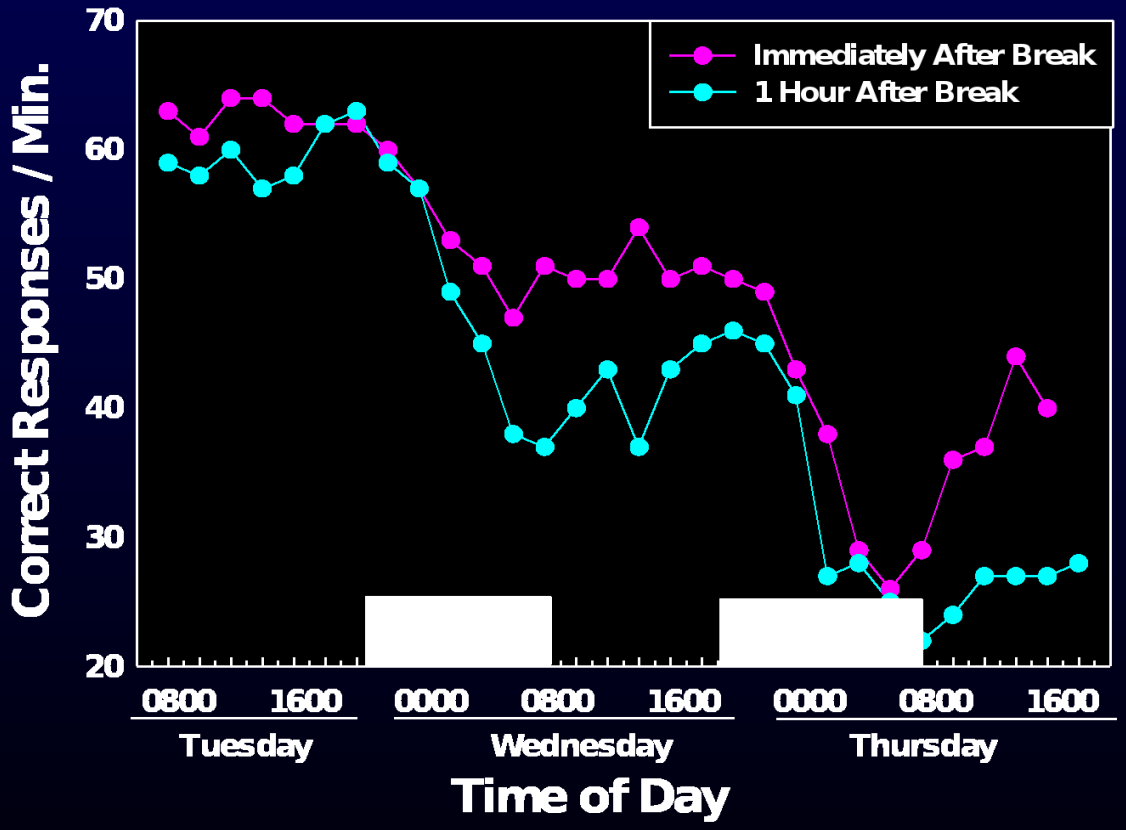


Source: Caldwell and Caldwell, 1998; Angus, et al., 1992

Implement Properly-Spaced Rest Breaks

- Long bouts of work produce fatigue and boredom which can seriously impair performance
  - Liberal rest breaks provide for physiological recovery, increased mental stimulation, and improved mood
  - Studies have shown that work breaks improve productivity and reduce subjective sleepiness
- Optimum schedules for breaks have not been determined
- However, a break at least every 2 hours is recommended when possible
- The more repetitious, boring, and tedious the task, the more frequently breaks should be scheduled

Short Breaks Temporarily Restore Performance

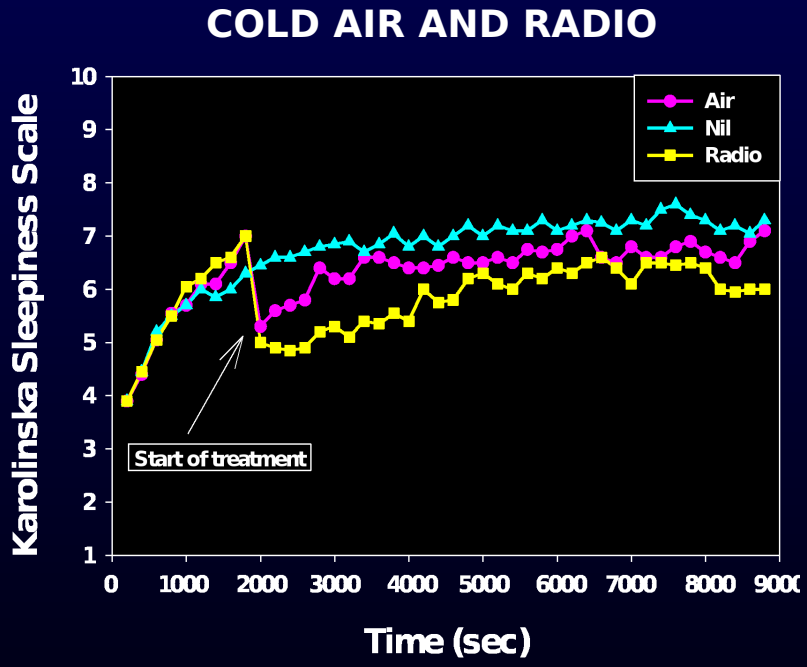


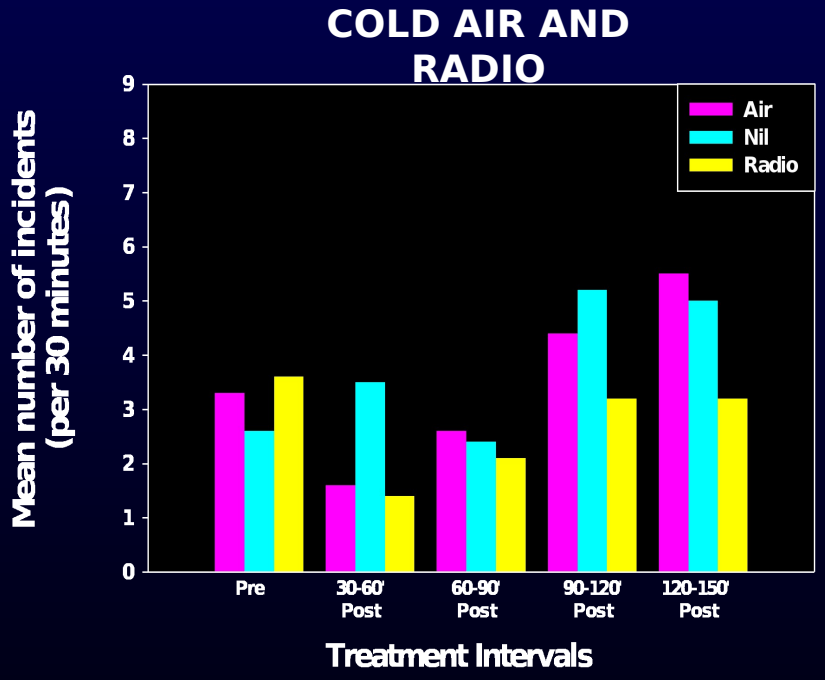
Source: Pigeau et al., 1995

Exercise, Cold Air, and Music Don't Really Help

- Some research shows that exercise can slightly improve alertness
  - However, the effect is short-lived (maybe 20 minutes) and probably leads to more fatigue later
  - Frequent exercise breaks aren't feasible in most aviation operations
- Listening to a radio *slightly* improves reaction time and decreases subjective sleepiness
  - However, there is no evidence that it improves driving or other types of performance
- "Cold air to the face" has not been proven to stave off fatigue

Dependence on These Strategies is Not Advisable





Source: Reyner and Horne, 1998

Physical Fitness is Not a Safeguard Against Mental Fatigue

- The Army has historically tried to decrease fatigue susceptibility by improving physical fitness
- This strategy works well in jobs which require physical labor
- However, it does not protect against mental fatigue
  - One study showed fewer subjective complaints from night workers after physical training, but actual performance was not affected
- Physical fitness may help you look better, pass the PT test, and live longer, but don’t depend on it to overcome fatigue!

Summary and Conclusions

- Fatigue is a major contributor to accidents, lost productivity, and poor quality of life
- As force reductions continue, the potential for fatigue-related problems will only increase
- However, safety, performance, and general well-being can be preserved by:
  - Adhering to good mission-scheduling practices
  - Implementing proven fatigue countermeasures
  - Providing sleep-conducive environments for off-duty crews
  - Making adequate daily sleep a top priority
- Remember, sleep is a physical necessity--not a luxury, and there is NO substitute for SLEEP!

GOOD Fatigue Management

BAD Fatigue Management